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(19)(CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Printing Machine with at Least One Interchangeable Cylinder

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ABSTRACT OF THE DISCLOSURE

A printing machine has first cylinders and first rollers or a first plate cylinder which carries a typeform installed in the printing machine in a mounting from which they can be removed and which are interchangeable for second cylinders or rollers or a second plate cylinder also carrying a typeform. The first cylinders or rollers, or the first plate cylinder carrying the typeform have fixed set interfaces for their correct side registry and circumferential registry in the printing machine which includes an exchange unit with a first gripper and cylinder exchange device. The first gripper takes the first cylinder or the first roller or the first plate cylinder together with the typeform out of their respective mounting and places the cylinder, roller or first plate cylinder into the cylinder exchange device, removes from the cylinder exchange device a second cylinder, second roller or second plate cylinder with associated typeform and again places the second cylinder, second roller and second plate cylinder with its typeform correspondingly into their respective mounting in the printing machine.

FIELD OF THE INVENTION

The invention relates to a printing machine with first cylinders and first rollers which are installed in the printing machine in a mounting from which they can be removed and which are exchangeable for second cylinders or rollers. In an alternative embodiment, the invention relates in particular to a printing machine with a first plate cylinder which is installed in the printing machine in a mounting from which it can be removed and carries a typeform and can, together with the typeform, be exchanged for a second plate cylinder, which also carries a typeform.

BACKGROUND OF THE INVENTION

In known flatbed printing machines, especially offset printing machines, it is necessary, when the image to be printed is changed, to change the typeforms. To do this, the entire printing machine must be stopped; the exchange of typeforms is generally done manually. However, automatic converting systems (robotics) are also known. In forms-printing machines, cylinders are exchanged manually, in part. In intaglio printing machines, the exchange of cylinders using cranes is a common procedure.

A printing machine is known from U.S. Pat. No. 5, 186, 103 which is used in particular for printing on a paper web of heavy or thick stock material and which has interchangeable cylinders. Because, in keeping with the various packaging materials to be printed on, the images to be printed are of various widths and lengths, it is necessary to use and exchange plate cylinders of various diameters. Either the plate cylinder alone (in direct printing) or the plate cylinder together with the blanket cylinder (in offset printing) is located in an interchangeable cassette, which can be removed from the printing tower in question of the printing machine. A hoist, which is attached movably to a rail, is used to remove the cassette. The hoist first draws the cassette upward and then transports it away, in order to exchange it for a different cassette with a plate cylinder or a plate cylinder coupled with a blanket cylinder which has or have a different diameter.

An exchange procedure of this type, which requires not only the removal of a single plate cylinder, but also the removal of a cassette located in the side wall of the printing

unit involved, is very expensive. It results in a long stoppage of the machine during the exchange of plate cylinders and the associated exchange of typeforms. When a printing machine is stopped, the sensitive water-ink equilibrium in the inking unit and the dampening unit of the printing machine is disturbed and must be newly adjusted.

Equally great expenditure is involved when a different cylinder, e.g., the blanket cylinder, or a roller, e.g., the form inking roller, is removed and changed, as is necessary when their covering surfaces become worn or dirty and on-the-spot cleaning is not possible. Similarly, the removal of an impression cylinder may be necessary when, for example, the material to be printed on is changed. The exchange of the form inking rollers may be advisable when the ink to be used in printing has different characteristics, e.g., a different viscosity.

It is therefore desirable to have a printing machine with printing structures installed in a mounting such as either a plate cylinder, carrying an associated typeform, or cylinders and rollers which are exchangeable for another plate cylinder, carrying an associated typeform, or other cylinders and rollers which addresses these problems.

SUMMARY OF THE INVENTION

An object of the present invention is therefore to provide a printing machine in which any desired cylinder or any desired roller can be easily changed, so that easy cleaning, as well as flexible exchange between printing jobs that require different rollers or cylinders, is possible.

This object is attained by an embodiment of the apparatus of the present invention which is a printing apparatus having a mounting disposed within the printing machine. A first cylinder is positionable within the mounting. The first cylinder has a fixed interface for establishing at least one of side and circumferential registration between the first cylinder and the mounting. A second cylinder is provided and also positionable within the mounting. Similarly, the second cylinder has a fixed interface for establishing at least one of side and circumferential registration between the second cylinder and the mounting. A cylinder exchanging assembly is provided for removing the first cylinder from the mounting. The cylinder exchanging assembly includes a gripper assembly and a cylinder exchange device for holding the second cylinder. The gripper is operable to exchange the first cylinder for the second cylinder in the mounting and to place the first cylinder in the cylinder exchange device, thereby exchanging the first cylinder and the second cylinder.

It is also the object of the present invention to create a printing machine in which the plate cylinder together with the typeform can be changed quickly and fully automatically.

This object is attained by a further embodiment of the present invention in which the first cylinder is a first plate cylinder having a removable first typeform on an outward surface thereof and in which the second cylinder is a second plate cylinder having a removable second typeform.

Other objects will be evident from embodiments of the apparatus of the present invention in which multiple printing units share a cylinder exchanging assembly.

It is particularly advantageous that after the used plate cylinder with the used typeform has been changed, the used plate cylinder can be renewed while printing is carried out with the newly substituted plate cylinder. This can be done by having, for example, the plate cylinder carry a conventional typeform that is exchanged manually for a new typeform, whereby the amount of time available for this exchange is equal to that during which the substituted plate cylinder is used in printing. The exchange of typeforms can also be carried out by a robot. Especially suitable, however, is a plate cylinder covered with a renewable typeform. During the time in which the substituted plate cylinder is being used in printing, the used typeform can be erased by an erasing device and then re-imaged. This is done, for example, by an ink printing process or a thermotransfer process using a foil that covers the plate cylinder. There is thus sufficient time available for renewing the surface of the plate cylinder. The fact that the plate cylinder is unloaded from the printing machine and is not re-imaged inside the machine itself means that no problems arise concerning space for the imaging unit.

Through the invention, defined interfaces are created between the printing machine, i.e., the mounting for the plate cylinder in the side walls of the printing machine, and

the plate cylinder itself. In order to install the plate cylinder correctly in the printing machine in respect to circumference and side register, there are, for example, movable bearing sleeves for the plate cylinder in the side walls in the direction of the longitudinal axis of the plate cylinder, plate cylinder clamping mechanisms, and serrations between the cylinder mounting and the plate cylinder. The distribution magazine which is used for the exchange of the plate cylinders preferably has a drum storage device, in which one or more plate cylinders are stored for exchange. The gripping, turning and lifting elements with which the plate cylinder is taken out of the printing machine and exchanged for another plate cylinder are preferably constructed in the manner of equipment of the type used in machine tools, e.g., CNC machine tools.

In a further embodiment, the plate cylinder to bear the typeform as an interchangeable sleeve. The sleeve can then be easily removed when the plate cylinder is first taken out of its mounting by a removal system, so that then, while the plate cylinder hangs by one of its journals, the sleeve can preferably be drawn vertically downward. Because of gravity, the weight of the sleeve will contribute to its being easily removable. The exchange of sleeves can thus be carried out without holes having to be provided in the side walls of the printing unit in question or a bearing having to be configured in one of the journals of the plate cylinder so as to make the cylinder swingable for the exchange of sleeves.

Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for the purposes of illustration

and not as a definition of the limits of the invention, for which reference should be made to the appended claims.

DETAILED DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like reference characters denote similar elements throughout the several views:

FIG. 1 is an inventive sheet-fed printing machine with an exchange unit with a gripper and a lifting device, in several positions, for the exchange of a plate cylinder constructed in accord with the teachings of the present invention;

FIG. 2 A sheet-fed printing machine with an exchange unit with a gripper and a lifting device, in several positions, for the exchange of a plate cylinder;

FIG. 3 A sheet-fed printing machine with an exchange unit with a gripper and a lifting device, in several positions, for the exchange of a plate cylinder;

FIG. 4 A sheet-fed printing machine with an exchange unit with a gripper and a lifting device, in several positions, for the exchange of a plate cylinder;

FIG. 5 Another step in exchanging the plate cylinder of the sheet-fed printing machine as in FIG. 1 to 4, showing an imaging station for the inkjet process;

FIG. 6 The same step in exchanging the plate cylinder as shown in FIG. 5, showing an imaging station for the thermotransfer process;

FIG. 7 A different rotary printing machine with an exchange unit for exchanging a plate cylinder;

FIG. 8 A sheet-fed printing machine with an exchange unit equipped with a drum storage device;

FIG. 9 A rotary printing machine with a satellite printing unit with an exchange unit that is equipped with a drum storage device;

FIG. 10 A cross-section of a plate cylinder and its mounting;

FIG. 11 A rotary printing machine with a plate cylinder that is encompassed by a typeform in the form of an interchangeable sleeve;

FIG. 12 A rotary printing machine with a plate cylinder that is encompassed by a typeform in the form of an interchangeable sleeve;

FIG. 13 A sheet-fed printing machine with a plate cylinder that is encompassed by a typeform in the form of an interchangeable sleeve;

FIG. 14 A sheet-fed printing machine with a plate cylinder that is encompassed by a typeform in the form of an interchangeable sleeve;

FIG. 15 A sheet-fed printing machine with a plate cylinder that is encompassed by a typeform in the form of an interchangeable sleeve;

FIG. 16 A sheet-fed printing machine with multiple printing units, above which a trolley is located.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Referring now to the drawings generally and with reference to each FIG. specifically, the present invention relates to printing machines 1, 16, 26, 38 having plate cylinders 5, 18, 28, 29, 60 to 63 carrying typeforms which, together with the typeforms, can be exchanged for plate cylinders 5', 18', 28', 29', 60' to 63' of the same design. The plate cylinders 5, 5'; 18, 18'; 28, 28'; 29, 29'; 60 to 63, 60' to 63' have fixed set interfaces proximately located thereupon for ensuring correct register, within the mounting, of the plate cylinders 5, 5'; 18, 18'; 28, 28'; 29, 29'; 60 to 63, 60' to 63' within the printing machines 1, 16, 26, 38 both axially (e.g. side-to-side) and circumferentially. The exchange unit has grippers 8, 10; 24; 34; 35; 41 to 44, for exchanging the used plate cylinders 5, 18, 28, 29, 60 to 63 for the corresponding plate cylinders 5', 18', 28', 29', 60' to 63'. The latter are taken, in each case, from a deposit magazine, e.g., the drum storage devices 36; 46, 67 or a chain storage device. Preferably, there is an imaging unit 14, 15; 25; 37; 48, 49, within or in the vicinity of the deposit magazine, in which the old printing image is first erased and then a new printing image is applied, e.g., using the inkjet process or the thermotransfer process. The individual drawings, which show representative embodiments constructed in accordance with the teachings of the present invention, will now be discussed in turn.

FIG. 1 shows a printing unit 1a of a sheet-fed printing machine 1 for use in the offset printing process which has a sheet storage magazine 2 which stores the sheets to be printed on, a sheet feeder 3, which feeds the sheets to an impression cylinder 4, on the

circumferential surface of which the sheets are printed on by a plate cylinder 5 via a blanket cylinder 6. Each respective cylinder 4, 5, 6 has a longitudinal axis for rotation thereabout.

The printed sheets are further transported from the impression cylinder 4 to a pickup drum 7. The pickup drum turns the printed sheets over to an impression cylinder, not shown here, of another printing unit of the printing machine 1.

For the purpose of exchanging the plate cylinder 5 with an exchange unit, the printing machine 1 is equipped with a gripper 8, a lifting device 9 and a double gripper 10, which is installed in a frame or rack 11. As shown in FIG. 1, the double gripper 10 is already carrying a plate cylinder 5', which can be exchanged for the plate cylinder 5 after the typeform of the latter has been used or when a different print job is to be carried out. The double gripper 10 functions as the cylinder exchange device and, as will be seen in detail below, is movable so that lifting device 9 may place a plate cylinder 5 into the double gripper and receive plate cylinder 5' in exchange therefor.

The gripper 8 is, for example, installed in the frame or rack 11 of the sheet-fed printing machine 1 so as to be swingable in the directions of a double arrow A. Additionally, as will become apparent from the discussion below, it may also be desirable in particular embodiments for gripper 8 to additionally be moveable in the direction of double arrow C'. The gripper 8 has two gripping arms 80, each of which is equipped at the end with a prong 82 and a clamping device 81. The prong 82 and clamping device 81 are situated and sized to respectively correspond to appropriate respective locations on the front sides of the plate cylinder

5, for example and as will become apparent in connection with FIG. 10, a seating slot 51 in a journal 520, of the plate cylinder 5.

Inking rollers 130, 131, 132 of inking unit 133 are housed within printing unit 1a. Inking rollers 130, 131, 132 are moveable in the direction of arrow B by use of arrangements known in the art and accordingly, for the sake of clarity, are not shown in FIG. 1.

The lifting device 9 is movable by, for example, a threaded spindle, a toothed rack or a chain drive, in the direction of a double arrow C. As shown, the lifting device is a threaded spindle 91 coupled to the side wall 12 of the sheet-fed printing machine 1.

Referring now to FIG. 2 which shows the arrangement of FIG. 1 during the exchanging of plate cylinder 5 for plate cylinder 5'. As can be seen, inking rollers 130, 131, 132 have moved in the direction of arrow B of FIG. 1. Similarly, double gripper 10 is shown as having moved to an intermediate position for receipt of plate cylinder 5.

The gripper 8 and lifting device 9 are arranged so that once prong 82 and clamping device 81 have been grasped by gripper 8, gripper 8 and plate cylinder 5 may move as a unit to a position where gripper 8 can release plate cylinder 5 so as to be carryable by lifting device 9.

The double gripper 10 has two lever arms 100, 101 each of which has a holding device 102, which can be drawn back and forth, for firmly clamping the plate cylinder 5 or the plate cylinder 5' that is to be exchanged for the plate cylinder 5 during the exchange operation.

FIG. 3, shows the arrangement of FIG. 1 wherein the plate cylinder 5 has been carried by lifting device 9 to a position where it may be received by double gripper 10.

FIG. 4 further shows that double gripper 10 is rotatable by 180 degrees, in the direction indicated by double arrow D, so that plate cylinder 5 may be moved out of the way and plate cylinder 5' may be placed in a position where it is receivable by lifting device 9.

The plate cylinder 5' can now be lowered by lifting device 9 for replacement into printing unit 1a. The plate cylinder 5, is located inside the rack 11 of the double gripper 10, printing 5' is in the prior position of printing cylinder 5 and the printing unit 1a is now prepared for a new printing sequence.

It will also be apparent that an alternative embodiment may be utilized in which the lifting device 9 is not needed, if the gripper 8 is equipped with an apparatus, for example, with extendable telescopic arms, capable of placing the plate cylinder 5 in a position where it can be received directly by the double gripper 10.

FIG. 5 shows a preferred embodiment of the present invention in which an imaging unit 14 is used. The imaging unit 14 is located in a rack 140, which is shown as integrated with the side walls 13 of the printing unit of the sheet-fed printing machine 1 and also includes the frame or rack 11 of the double gripper 10. The imaging unit 14 includes an erasing device 141. The erasing device 141 is, for example, a plasma torch which is integrated with the rotational axis of the double gripper 10. By means of a motor that is not shown here, the plate cylinder, for example plate cylinder 5, is movable rotatably in a lever arm, for example the lever arm 100, of the double gripper 10, which carries it. In this way, the image which the typeform carries on its cylindrical surface can be erased by the plasma torch while the plate cylinder 5 completes a rotation around its mounting in the lever arm 100. The imaging unit 14

also includes an imaging device 142, which is used to inscribe a new typeform on the cylindrical surface of the plate cylinder 5 using, for example, an inkjet process or laser ablation. The imaging device 142 is located on a holder 143 so as to be movable in the directions of a double arrow E, so that during swinging movements of the double gripper 10 it can be pushed to the side, for example, by means of a motor. In addition, there is a fixing device 144, for example, an infrared radiator, for fixing the image produced by the imaging device 142. Fixing device 144 also can be moved out of the swing area of the double gripper 10.

In operation, the apparatus of FIGS. 1 to 5 work as follows.

When the plate cylinder 5 is to be changed, e.g. exchanged for plate cylinder 5', the inking unit rollers 130, 131 132 of an inking unit 133 of printing unit 12 of the sheet-fed printing machine 1, lying in the swing area of the plate cylinder 5, are swung away from the plate cylinder 5. Once the inking unit rollers 130, 131, 132 have moved, the prong 82 and the clamping device 81 on the gripping arm 80 of the gripper 8 engage into the respective side seating slots 51 of the plate cylinder 5. The clamping device 81 presses the journal 520 of the plate cylinder 5 against the prong 82, and the gripper 8 moves in the direction of the lifting device 9, which with its two side prongs carries the plate cylinder 5 in seating slots 52 also provided for this purpose in its journal 520.

After the gripper 8 has turned the plate cylinder 5 over to the lifting device 9, the lifting device 9 carries the plate cylinder 5 upward in order to turn it over to the double gripper 10 (FIG. 2). The latter has already been swung toward the lifting device 9 in order to receive

the plate cylinder 5. In turn, the double gripper 10, with its two prongs in the seating slots 51 of the plate cylinder 5, picks up the plate cylinder 5 on a lever arm 100.

After the double gripper 10 (FIG. 3) has taken over the plate cylinder 5 from the lifting device 9 and has firmly clamped the plate cylinder 5 by means of the holding device 102, the lifting device 9 again moves downward (double arrow C) out of the swing area of the double gripper 10.

Then the double gripper 10 rotates by 180 degrees (FIG. 4) in order to bring the plate cylinder 5' into the pick-up position for the lifting device 9. The lifting device 9 is again moved upward, until it reaches the position in which it takes over the plate cylinder 5', as soon as the holding device 102 of the double gripper 10 that is holding the plate cylinder 5' is released.

The plate cylinder 5' (FIG. 5) is then brought by the lifting device 9 and the gripper 8 into its printing position in reverse order but in the same manner that the plate cylinder 5 was previously removed from its position in the printing unit 12 of sheet-fed printing machine 1. The inking unit rollers 130, 131 and 132 are then swung back e.g. in the reverse direction to the direction of movement described above in FIG. 1 by double arrow B.

Alternatively, as shown in FIG. 6, a different type of imaging unit can be provided, which is located in a rack 150 and includes an erasing device 151, for example, a plasma torch integrated with the rotational axis of the double gripper 10. In this embodiment, the imaging unit 15 has an engraved roller 152 with an integrated heater. The plate cylinder 5 is movable to a position 52. An image is imprinted using a foil 153 onto the plate cylinder 5

and is fixed on the typeform by a fixing device 156. During use, the imprinting foil 153 is unwound like a film from a cassette 154, and the used imprinting foil 153 is rewound into a cassette 155. Thus, the imaging sequence may be carried out while sheets are being printed with an image on the plate cylinder 5'.

It is important for the imaging unit 14 or the imaging unit 15 to be installed in a vibration-free manner. If the imaging unit is located above the printing tower, suitable absorption means are provided, in order to capture the vibrations of the cylinder. If such a measure is not sufficient, the imaging unit is located next to or below the printing tower.

It will also be recognized and understood that instead of exchanging a plate cylinder 5 for a plate cylinder 5', as has been described above, the apparatus of the present invention makes it equally possible to exchange other cylinders, for example, the blanket cylinder 6 or the impression cylinder 4, or one or more of the inking rollers 130, 131, 132.

Where other cylinders are to be exchanged, the mountings of the cylinders or rollers must have eccentrics. In this embodiment, the gripper 8 must be able to swing out the cylinders and rollers from the mountings in question. For this purpose, the gripper 8 has, for example, telescopic arms, the length of which can be changed. Thus, for this, the gripper 8 is preferably slidable in the direction of a double arrow C' (FIG. 1 to 6).

FIG. 7 shows a rotary printing machine 16 for printing using the offset printing process on a stock web 17 by means of a plate cylinder 18, a blanket cylinder 19 and an impression cylinder 20. The rotary printing machine 16 also includes an inking unit 21 and a dampening unit 22.

Form inking rollers 210, 211 and form dampening roller 220 lie on or proximate to the surface of the plate cylinder 18. The rollers are movably mounted to enable them to swing out of the way of plate cylinder 18. As preferred, rollers 210, 211, 220 swing away from plate cylinder 18 so as to allow plate cylinder 18 to move away from blanket cylinder 19, shown for illustration purposes as in the direction of arrow G. As will be recognized by those in the art, for clarity, the apparatus which is used for movement of rollers 210, 211, 220 and plate cylinder 18 is not shown. When the rollers 210, 211, 220 are swung away from the surface of the plate cylinder 18 and the plate cylinder 18 is moved slightly away from the blanket cylinder 19 within the printing machine 16, for example, in the direction of arrow G, the plate cylinder can be removed from the rotary printing machine 16, for example, by means of a cylinder exchange device in the form of a gripping-and-turning system 24 located movably on a rail frame 23, and which is movable towards and away from rotary printing machine 16 as shown by double arrow F. The gripping-and-turning system 24 is constructed as a double gripper and, for example, is similar in design to the double gripper 10 shown in FIGS. 1 through 6. The gripping-and-turning system 24 picks up the plate cylinder 18 with one of its arms 240. On its other arm 241 it carries a plate cylinder 18' to be exchanged for the plate cylinder 18.

The gripping-and-turning system is preferably centrally located between the rotary printing machine 16 and an imaging device 25 so that the arms 240, 241 may complete a turning movement of 180° without interference. Accordingly, the plate cylinder 18' can then be placed into the position of the plate cylinder 18 in the rotary printing machine 16. After the exchanged plate cylinder 18' is positioned on the blanket cylinder 19 and the form inking rollers 210, 211

and the form dampening roller 220 are swung back, the printing sequence for printing on the stock web 17 may be continued. Having now received the plate cylinder 18, the gripping-and-turning system 24 transports the plate cylinder 18 from the rotary printing machine 16 towards the imaging unit 25. Imaging unit 25 includes an erasing device 250, an imaging device 251 and a fixing device 252. As with the devices shown in FIG. 5 and FIG. 6, the printing image of the typeform on the cylindrical surface of the plate cylinder 18 is first erased by the erasing device 250, and then a new image is provided by the imaging device 251. In addition, there may also be another fixing device 252 available, with which the new printing image can be fixed.

FIG. 8 shows a sheet-fed printing machine 26 which has its own printing unit or tower 27 for two-color printing. Accordingly, the sheet-fed printing machine 26 contains two plate cylinders 28, 29, each of which transmits an image via a blanket cylinder 30 or 31 onto a sheet, which is held on the surface of an impression cylinder 32 and after being imprinted, is transported away via a transfer device 320.

For the sake of simplification, the inking unit and the dampening unit are not shown in detail in FIG. 8. To exchange the plate cylinder 28, 29 in a single operation, when the subject to be printed is changed, there is a gripping-and-turning system, which includes the grippers 34 and 35 as well as a drum storage device 36. In this embodiment, the grippers 34, 35 grip the plate cylinders 28 and 29, respectively, with holding and clamping devices which operate similarly to those discussed and which, for purposes of clarity, are not shown. The grippers 34, 35 draw the plate cylinders 28, 29, respectively, out of the printing unit or tower

27 in the directions of arrows G and J, respectively, and swing the plate cylinders 28, 29 in the direction of arrows I and H toward the empty drums 360, 361 of the drum storage device 36, in order to deposit them therein. In two additional drums 362, 363, the drum storage device 36 carries the new plate cylinders 28', 29' which are to replace the old plate cylinders 28, 29. The drum storage device 36 may then rotate by 180° to move new plate cylinders 28' and 29' into the position for loading into printing unit or tower 27. In this position, the new plate cylinders 28', 29' are moved in a reverse operation by the grippers 34 or 35 and brought into the correct positions within the printing tower 27. As with the embodiments discussed above, while printing is being carried out with the plate cylinders 28', 29', the circumferential surfaces of the old plate cylinders 28, 29 are furnished with new printing surfaces by an imaging unit 37. Additionally, printing tower 27 may also have erasing, imaging and fixing devices as explained above with reference to FIG. 5 and FIG. 7, but are not shown herein.

FIG. 9 shows a rotary printing machine 38 for four-color printing, on a printing stock web 40, with a satellite printing unit 39. There is a gripping-and-turning system on each side of the printing tower with the grippers 41, 42 and 43, 44, respectively. The grippers 41 to 44 are, for example, attached to the rotational axis of the central impression cylinder 45 of the satellite printing unit 39. On both sides of the satellite printing unit 39 there are drum storage devices 46, 47, which have, in each case, two empty drums and two drums containing the new plate cylinders 60' and 62' or 61' and 63', respectively, to be exchanged for the used plate cylinders 60 to 63, and which form, respectively, a cylinder exchange device. The exchange process is carried out with the two gripping-and-turning systems in a manner similar

to that described above with reference to the sheet-fed printing machine 26 of FIG. 8. Again, as described above, the imaging units 48, 49, are equipped with an erasing, an imaging, and a fixing device which may produce new printing images on the circumferential surfaces of the plate cylinders 60, 52 and 61, 63 while printing is being performed with plate cylinders 60', 62' and 61', 63'.

It will also be recognized by those skilled in the art that chain storage devices may be utilized in place of the drum storage device 36 or 46, 47.

It will further be recognized and understood with respect to the embodiments discussed above that, in addition to the plate cylinders 28, 28', 29, 29' or 60 to 63', additional drums, other cylinders and/or rollers 4, 6, 130, 131, 132 or 19, 20, 210, 211, 220 or 30, 31, 32 or 45 may also be adapted so as to be exchangeable, for example, for replacement due to wear or for cleaning, with corresponding drums, other cylinders and/or rollers stored utilizing a chain storage device or the drum storage device 36 or 46, 47 in accordance with the teachings of the present invention.

For example, and in particular, where the drum, cylinder or the roller is merely dirty, it can be cleaned by a cleaning device 365 or 465, 475 located next to the chain or drum storage device 36 or 46, 47. The respective cleaning devices 365 or 465, 475 are attachable to and detachable from the chain or drum storage device 36; 46, 47. Where cleaning is a contemplated function, a suitable motor should be coupleable to the drum, cylinder or roller so that during cleaning, the drum, cylinder or roller will turn about its longitudinal axis in the chain or drum storage device 36; 46, 47.

Referring now to FIG. 10, and as previously noted in connection with FIG. 1, the gripper 8 has two gripping arms 80, each of which is equipped at the end with a prong 82 and a clamping device 81, which fit respectively collateral to the front sides of the plate cylinder 5 into a seating slot 51 in a journal 520 of the plate cylinder 5. Similarly, the lifting device 9 has two side prongs which engage the plate cylinder 5 via seating slots 52 in journal 520.

The plate cylinder 5 is installed, using a journal pin 505, above a mounting 50 in the side wall 13. The mounting 50 has a bearing bushing 500 with hydraulic clamping, in which a bearing sleeve 501 is movably located within an area *d* parallel to the longitudinal axis of the plate cylinder 5. Via an axial bearing 503 and a radial bearing 504, the journal pin 505 for the plate cylinder 5 is movably located in the bearing sleeve 501. The journal pin 505 is also equipped with a plate cylinder clamping mechanism 506, which has clamping jaws 507. The clamping jaws 507 encircle a corresponding fastening pin 508 of the plate cylinder 5 and are, for example, pneumatically loaded and relieved. In addition, the plate cylinder 5 and the journal pin 505 each have a corresponding serration 509, for example, a Hirth-type serration, through which the plate cylinder 5 is held and centered on the shaft. The plate cylinders 5', 18, 18', 28, 28', 29, 29' and 60 to 63 and 60' to 63' are installed in a similar or identical manner.

It will be further recognized and understood that

instead of the serration 509 shown here, other types of serrations may be used, for example, serrations in which the teeth are slanted at the roots, so that the plate cylinder 5 is self-centering when placed in the printing machine, and further, in order to precisely establish the position of

the plate cylinder 5 during its removal or during its return, mechanical, optical or electronic positioning means can be used alone or in conjunction with the serrations.

Furthermore, a correct mounting of a cylinder in terms of circumferential register is important, not only in the case of the plate cylinder, but also for example, in the case of the blanket cylinder, if the latter has no seamless rubber sleeve. Correct mounting is also important in the case of the form inking roller, if the plate cylinder has one or more channels and the form inking roller has corresponding reliefs in the contour of its core where, instead of the core material, there are thickenings of its outer covering, which respectively roll off the channels of the plate cylinder.

In another embodiment of the present invention shown with reference to FIGS. 11 and 12, a rotary printing machine 16 as for example, disclosed in DE 35 43 704 A1, is equipped with a plate cylinder 95, the typeform of which is designed as an interchangeable sleeve 96 which is held frictionally on the covering of the plate cylinder. In accord with the teachings of the present invention, the plate cylinder 95, like the plate cylinder 18 of FIG. 7, is lifted out of the rotary printing machine 16 by a removal system 90 by means of gripper 92 and gripper 93 which is blocked from view by gripper 92 in FIG. 11 but is visible in FIG. 12. The grippers 92 and 93 respectively, hold the plate cylinder 95 in the slots 51 in its journals 520, 520'. The removal system 90 then moves on the rail frame 23 away from the printing unit and rotates the plate cylinder around a rotational axis 900 into the vertical position. The gripper 93 is swung downwards in the direction of an arrow K from the journal 520', and configured in a manner known to those in the art so that the plate cylinder 95 is freely accessible from below and its sleeve 96 can be exchanged for a replacement sleeve by an exchange device not shown here. Then the gripper 93 moves back into the holding position, the plate cylinder 95

is returned to the horizontal position and replaced into the printing unit 16 for the continuation of the printing process.

FIG. 13 shows the sheet-fed printing machine 1 of FIG. 1 employing the plate cylinder 95 with an interchangeable sleeve 96 of FIGS. 10 and 11. As will be readily apparent, the other parts and elements correspond to the parts and elements identified and described above and are therefore not discussed. The lifting device 9 has two gripping arms 901, 902. The gripping arm 901 has a clamping device (not shown here) with which it can clamp and hold the plate cylinder 95 by its journal 520. Preferably, the gripping arm 901 can also be moved individually relative to the gripping arm 902. By means of the clamping device, gripping arm 901 grips the journal 520' of the plate cylinder 95 and rotates the latter by 90° with respect to its rotational axis when installed, i.e. in the direction of an arrow L. In this position, the sleeve 96 of the plate cylinder 95 can, by means of a known withdrawal device attached in a hanging fashion and not shown here, be taken off the plate cylinder 95 and exchanged for a replacement sleeve. After the replacement sleeve is put into place, the plate cylinder 95 is replaced, in the reverse sequence of movements hereinabove described, into the printing tower of the sheet-fed printing machine 1.

Referring now to FIG. 14 which again shows the sheet-fed printing machine 1 however, with a frame 11', which is of larger design than the frame 11 of FIG. 13 and which is located above the printing tower. The gripping arm 901 of the lifting device 9 is again so designed that by itself it can carry the plate cylinder 95 with the interchangeable sleeve 96. In contrast to the embodiment of the invention shown in FIG. 13, the gripping arm 901 rotates the plate cylinder 95 by 90° downward, so that the latter hangs vertically on the gripping arm. The other gripping arm 902 of the lifting device 9 is preferably movable downwards in the direction

of double arrow C, in order to create space for sleeve 96 to be removed. Once gripping arms 901 and 902 have been moved to their proper respective locations, using a removal device, not shown here, the sleeve 96 of the plate cylinder 95 can then be pulled downward.

A still further embodiment of the present invention is shown in FIG. 15, in which frame 11 or 11' are removed or unnecessary. Again the plate cylinder 95 is held and clamped firmly by the gripping arm 901 of the lifting device 9. However, because in this sheet-fed printing machine 1 the frame 11 or 11' is not present, the plate cylinder held on the gripping arm 901 can be rotated in the horizontal plane in the direction of an arrow M, around its journal 520' above the printing tower after the other gripping arm 902 of the lifting device 9 is moved as hereinabove discussed a distance downward out of the swing area of the gripping arm 901. Then the sleeve 96 can be pulled off horizontally by a removal device, not shown, from the plate cylinder 95 and exchanged for a replacement sleeve. Through a reverse sequence of movements, the plate cylinder 95 is again placed in its mounting 50 in the sheet-fed printing machine 1.

FIG. 16 shows a sheet-fed printing machine 400 with five printing towers 401, 402, 403, 404 and 405, each of which is equipped like the printing tower of the sheet-fed printing machine 1, shown in FIGS. 1 to 6. For reasons of clarity in the drawing, reference should be made to the aforementioned drawings. The sheet-fed printing machine 400, like the sheet-fed printing machine 1, also has a sheet storage magazine 2, a sheet feeder 3 and a hoisting device 406 for placing the printed sheets in a stack 407. In addition, each of the printing units 401 to 405 has a gripper 408 to 412, which is designed, for example, like the gripper 8 in FIG. 1 to FIG. 6 and which preferably has gripping arms that can be extended telescopically. In this way, the gripper can remove each cylinder or each roller from the

respective printing units 401 to 405 and position the cylinder or roller in the area between the printing towers 401 to 405 in such a way that a trolley 414 located on a rail 413 above the sheet-fed printing machine 400, which has a telescopic arm 415, can grip the cylinder or the roller. Then the trolley 414 transports the cylinder or the roller either to an exchange device not shown, which in turn has, for example, a drum storage device as shown in FIGS. 8 and 9, or to a cleaning device 416 in which the cylinder or roller is cleaned.

If the cylinder is a plate cylinder with a renewable typeform, the trolley 414 transports the cylinder to an erasing device 417. There the image which the typeform displays on its cylindrical surface is erased. Then the typeform is provided with a new image in an imaging device 418. The new printing image is then fixed in a fixing device 419. The cylinder is placed on the telescopic arms 415 in such a way that it can be rotated by means of a motor, so that it can be rotated on its longitudinal axis during the erasing, imaging and fixing process or during cleaning.

Instead of the trolley 414, which is installed in hanging fashion, there can also be a device that stands to the side of the printing units and is movably installed next to the printing units 401 to 405 either on a rail system or controlled inductively by a wire system located, for example, along or embedded in the underlying floor, or through optical or electrical waves. This device then works together with the grippers 408 to 412 to remove the cylinder or rollers from the printing towers 401 to 405, in order to exchange them for others, clean them, or, in the case of plate cylinders, put new images on them.

It will be further recognized and understood that if the printing machines 1, 16, 26, 38 have multiple printing units, then the exchange units with their grippers 8; 24; 34; 35; 41 to 44 and the cylinder exchange devices 10; 24; 36; 46; 47 as well as the removal system 90

can be located, in each case, between two printing units and can carry out the exchange of any desired cylinders and rollers in these units. For this purpose, the exchange units with the grippers 8; 24; 34; 35; 41 to 44 and the cylinder exchange devices 10; 24; 36; 46, 47 are preferably installed so as to be rotatable around their respective vertical axes.

Instead of the form cylinders 5, 18, 28, 29, 60 to 63, it is also possible to exchange other cylinders or rollers 4, 6, 130, 131, 132; 19, 20, 210, 211, 220; 30, 31, 32; 45. The plate cylinder 95 can also be covered with an interchangeable sleeve 96 which constitutes the typeform.

The invention described in respect to the sheet-fed and rotary printing machines 1, 16, 26, 38, 400 for the offset printing process is not limited thereto, and thus can also be applied to printing machines used in other types of printing processes, for example, intaglio printing. In another embodiment of the invention, a rotary or sheet-fed printing machine 1, 16, 26, 38, 400 has multiple printing units, between which an exchange unit of the robotic type is disposed so as to be moveable among the multiple units in order to remove cylinders or rollers from the mountings 50 and exchange them for corresponding cylinders or rollers, which are stored in a fixed cylinder device, for example, a chain or drum storage device not coupled to the printing machine. The exchange unit can also transport the cylinder or roller to a stationary cleaning device, or, if the cylinders are plate cylinders, to an imaging unit which may also be located remote from the printing machine.

Thus, while there have been shown and described and pointed out fundamental novel features of the invention as applied to preferred embodiments thereof, it will be understood that various omissions and substitutions and changes in the form and details of the disclosed invention may be made by those skilled in the art without departing from the spirit of the

invention. It is the intention, however, therefore, to be limited only as indicated by the scope of the claims appended hereto.

CLAIMS

What is claimed is:

1. A printing machine (1, 16, 26, 38) having side walls, comprising:

a first plurality of cylinders and a first plurality of rollers (4, 6, 130, 131, 132; 19, 20, 210, 211, 220; 30, 31, 32; 45) arranged between the side walls of the printing machine;

a mounting (50) disposed in a side wall for supporting one of the cylinders and rollers, the mounting comprising means for attaining at least one of side registry and circumferential registry of the cylinders and rollers in the printing machine (1, 16, 26, 38);

and an exchange unit comprising a first gripper (8; 24; 34; 35; 41 to 44) and a cylinder exchange device (10; 24; 36; 46, 47), said first gripper (8; 24; 34, 35; 41 to 44) being operable for removing one of the first cylinder and the first roller (4, 6, 130, 131, 132; 19, 20, 210, 211, 220; 30, 31, 32; 45) from the mounting (50), for placing the cylinder or roller in the cylinder exchange device (10; 24; 36; 46, 47), for removing from the latter one of a second cylinder and second roller, and for again placing the cylinder or roller correspondingly into the mounting (50) in the printing machine (1, 16, 26, 38).

2. A printing machine (1, 16, 26, 38) having side walls, comprising: at least one first plate cylinder (5; 18; 28, 29; 60 to 63) disposed between the side walls; a typeform carried by the plate cylinder;

a mounting (50) disposed in a side wall of the printing machine for supporting the plate cylinder, the mounting comprising means for attaining one of side registry and circumferential registry of the plate cylinder in the printing machine (1, 16, 26, 38);

and an exchange unit comprising a first gripper (8; 24; 34, 35; 41 to 44) and a cylinder exchange device (10; 24; 36; 46, 47);

said first gripper (8; 24; 34, 35; 41 to 44) being operable for removing the first plate cylinder (5; 18; 28, 29; 60 to 63) out of the mounting (50), for placing the first plate cylinder in the cylinder exchange device (10; 24; 36; 46, 47), for removing from the cylinder exchange device a second plate cylinder (5'; 18'; 28', 29'; 60' to 63') and for correspondingly placing the second plate cylinder into the mounting (50) in the printing machine (1, 16, 26, 38).

3. The printing machine (1) of Claim 1, wherein the exchange unit further comprises a second gripper (10) and a lifting device (9) for picking up one of the first cylinder and the first roller from the first gripper (8) and for turning the first cylinder or first roller over to the second gripper (10) and for accepting the second cylinder or the second roller from the second gripper (10) and for turning the second cylinder or second roller over to the first gripper (8).

4. The printing machine (1, 16) of Claim 3, wherein one of the first gripper (8) and the second gripper (10) is constructed as a double gripper (10, 24), having two lever arms and being swingable around the midpoint of the two lever arms (100, 101; 240, 241) for picking up the first cylinder or the first roller with one of the lever arms (100, 240) and for turning over the second cylinder or the second roller from the second lever arm (101, 241).

5. The printing machine (1, 16) of Claim 3, additionally including means comprising one of a threaded spindle (91), a toothed rack and a chain drive for raising and lowering said lifting device (9).

6. The printing machine (1, 16, 26, 38) of Claim 1, wherein the gripper (8; 24; 34, 35; 41 to 44) comprises an arm (80); a prong (82) at the end of the arm (80); and means (81) disposed at the arm for clamping the cylinder or the roller against the prong (82).

7. The printing machine (16) comprising at least one plate cylinder (95) having journals at the end thereof;

a typeform in the form of a sleeve held frictionally (96) on the plate cylinder;

a mounting (50) for supporting the plate cylinder (95) in the printing machine (16) comprising means for attaining side registry and circumferential registry of the plate cylinder in the printing machine (16);

a removal device (90) associated with the printing machine for removing the plate cylinder (95) from the mounting (50);

said removal device comprising a holder (92) for holding the plate cylinder (95) on one of the journals (520), while the other journal (520') is free; and

a sleeve exchange device for withdrawing the sleeve (96) from the plate cylinder (95) and for exchanging the sleeve with a replacement sleeve.

8. The printing machine (16) of Claim 7, wherein the plate cylinder has transverse axes and wherein the removal device (90) further comprises two gripping arms (92, 93), for swinging the plate cylinder (95) out of the mounting (50), and for rotating the plate cylinder (95) around one of the transverse axes so that the plate cylinder (95) hangs vertically from one of the gripping arms (92), and so that the other gripping arm (93) is swung away from the plate cylinder (95) thereby permitting the plate cylinder to hang freely and for permitting the downward withdrawal of the sleeve.

9. The printing machine (1, 16, 26, 38) of Claim 7, wherein the plate cylinder is part of a printing unit and wherein one of the cylinder exchange device (10; 24; 36; 46, 47) and the removal device (90) is located one of next to, below and above the printing unit of the printing machine (1, 16, 26, 38).

10. The printing machine (26, 38) of Claim 1, wherein the cylinder exchange device (10; 24; 36; 46, 47) comprises a deposit magazine having one of a drum storage device (36; 46, 47) and a chain storage device.

11. The printing machine of Claim 10, additionally comprising means in one of the drum storage device and chain storage device for rotating the cylinders or rollers around their longitudinal axis and for cleaning the circumferential surface thereof.

12. The printing machine (1, 16, 26, 38) of Claim 2, wherein the cylinder exchange device (10; 24; 36; 46, 47) comprises an imaging unit (14, 15; 25; 37; 48, 49) for

putting a new image on the first plate cylinder (5; 18; 28, 29; 60 to 63); and means for rotating the plate cylinder during imaging around its longitudinal axis.

13. The printing machine (1, 16) of Claim 12, wherein the imaging unit (14, 15; 25) comprises an erasing device (141, 151; 250) for erasing the printing image of the first plate cylinder (5; 18; 28, 29) and an imaging device (142, 152; 251) for producing a new printing image on the first plate cylinder (5; 18; 28, 29).

14. The printing machine (1, 16) of Claim 13, wherein the imaging unit (14, 15, 25) further comprises a fixing device (144, 156, 252) for fixing the printing image on the typeform of the plate cylinder (18).

15. The printing machine (1) of Claim 13, wherein the imaging unit (14, 15) includes means for applying an image by one of inkjet, laser ablation and thermotransfer process.

16. The printing machine (1) of Claim 3, additionally comprising means (51, 52) for engaging the first gripper (8) and the second gripper (10) and the lifting device (9) with the cylinders or the rollers.

17. The printing machine (1) of Claim 16, wherein the cylinders or the rollers comprise a serration (509) at the end faces thereof.

18. The printing machine of claim 17, in which the serration is a Hirth-type serration.

19. The printing machine (1) of Claim 1, additionally comprising a cylinder clamping device (506) in the side wall; said cylinder clamping device comprising a clamping pin for holding one of the cylinders and rollers.

20. The printing machine (1) of claim 1, wherein the mounting (50) further comprises a stationary bearing bushing (500) disposed in the side wall; a bearing sleeve (501) movable with respect to the bearing bushing (500) in the direction of the longitudinal axis of the cylinders or rollers for permitting the removal thereof.

21. The printing machine (1, 16, 26, 38) of Claim 1, wherein the gripper (8, 10, 34, 41 to 44) comprises telescopic gripping arms for removing the cylinder or the roller from the mounting.

22. The printing machine (1, 16, 26, 38) of Claim 1, wherein the cylinder exchange device (10; 24; 36; 46, 47) comprises a rail system (23).

23. The printing machine (1, 16, 26, 38) of Claim 2, additionally comprising means in the cylinder exchange device (10; 24; 36; 46, 47) for interchanging the typeform on the plate cylinder (5, 5'; 18, 18'; 28, 29, 28', 29', 60 to 63, 60' to 63) manually or by a robot.

24. The printing machine (1, 16, 26, 38) of Claim 1, comprising two or more printing units, and wherein the exchange unit (8; 24; 34, 35; 41 to 44) and the cylinder exchange device (10; 24; 36; 46, 47) are located between two of the printing units for the exchange of the cylinders or rollers in the printing units.

25. The printing machine (1, 16, 26, 38) of Claim 1, comprising two or more printing units, and means next to the printing unit for guiding the exchange unit (8; 24; 34, 35; 41 to 44) and the cylinder exchange device (10; 24; 36; 46, 47); said guiding means comprising one of a rail system and a system controllable inductively by means of a wire system running below the floor or through electrical or optical waves.

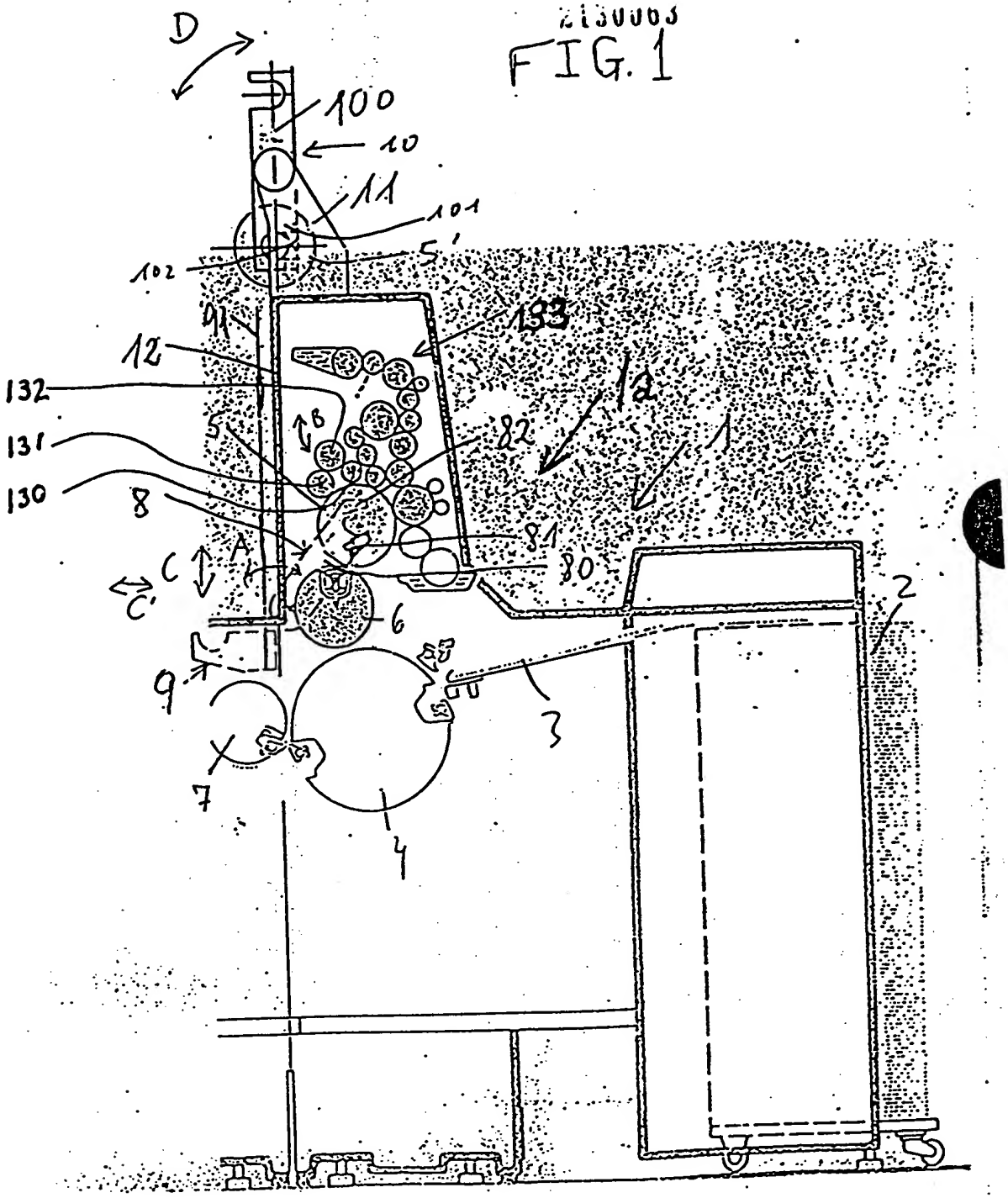
26. The printing machine (1) of Claim 7, additionally comprising a lifting device having two gripping arms (901, 902) of which one (901) is mounted for rotation around one of its vertical and horizontal axis, for swinging the plate cylinder (95) with its sleeve (96) into a horizontal or a vertical position so that the plate cylinder either stands or hangs for permitting the sleeve (96) to be drawn either horizontally to the side, vertically upward or vertically downward.

27. The printing machine (400) of claim 1, comprising a plurality of said printing units (401 to 405) and a trolley (414) located movably on a rail (413) above the printing machine for taking over the rollers or cylinders from grippers (408 to 412) located between the printing units (401 to 405) or for turning the rollers or cylinders over to the grippers;

a stationary cleaning device (416) disposed adjacent the printing unit for cleaning the cylinders or rollers.

28. The printing machine (1, 16, 26, 38, 400) of Claim 1, comprising a plurality of printing units (401 to 405), and further comprising a robot-type freely movable exchange unit disposed between the printing units for exchanging the cylinders or rollers from the mounting (50), for depositing the cylinders or rolls in the cylinder exchange device, and for taking cylinders or rollers out of the exchange device.

FIG. 1



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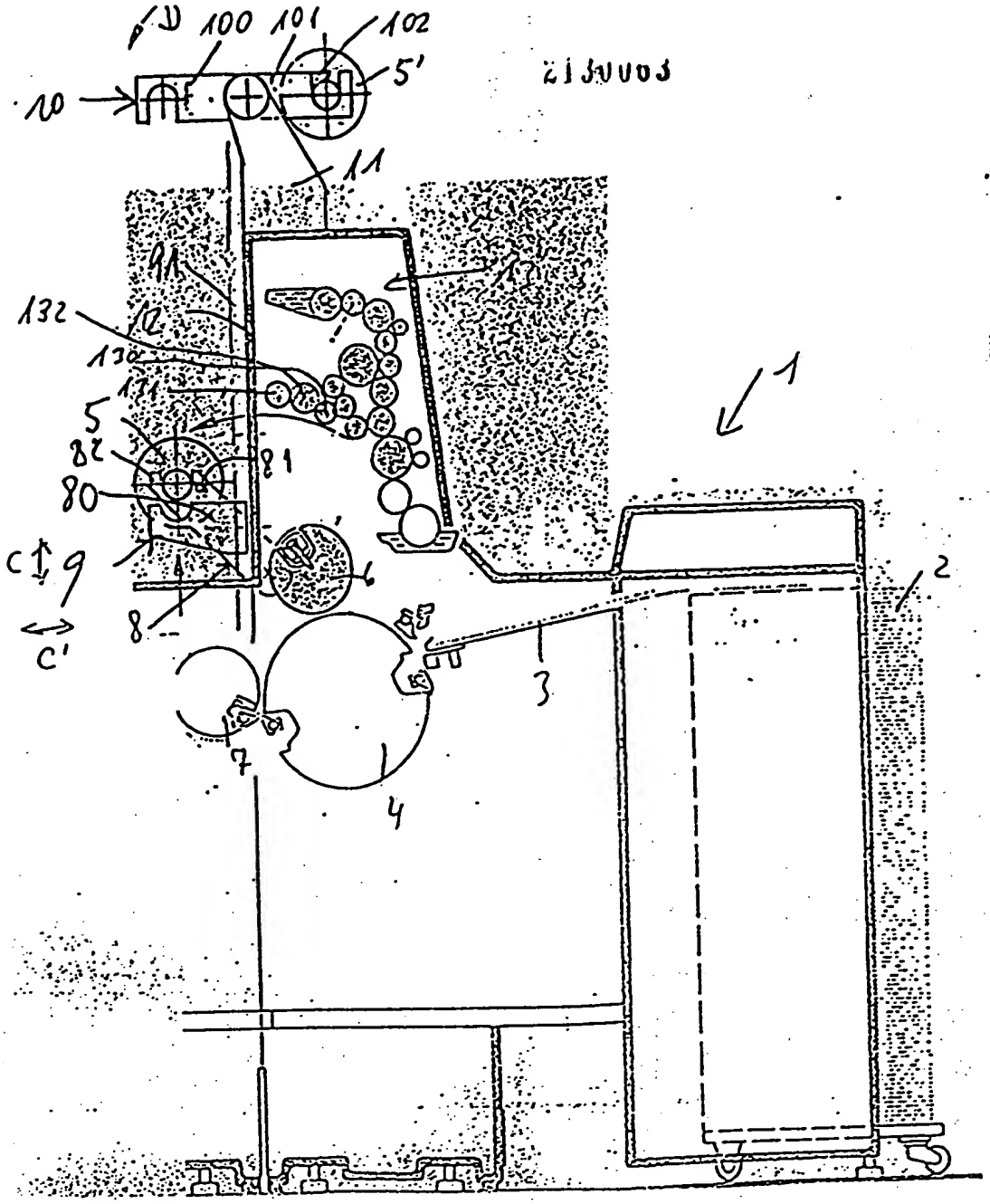

Fig. 2

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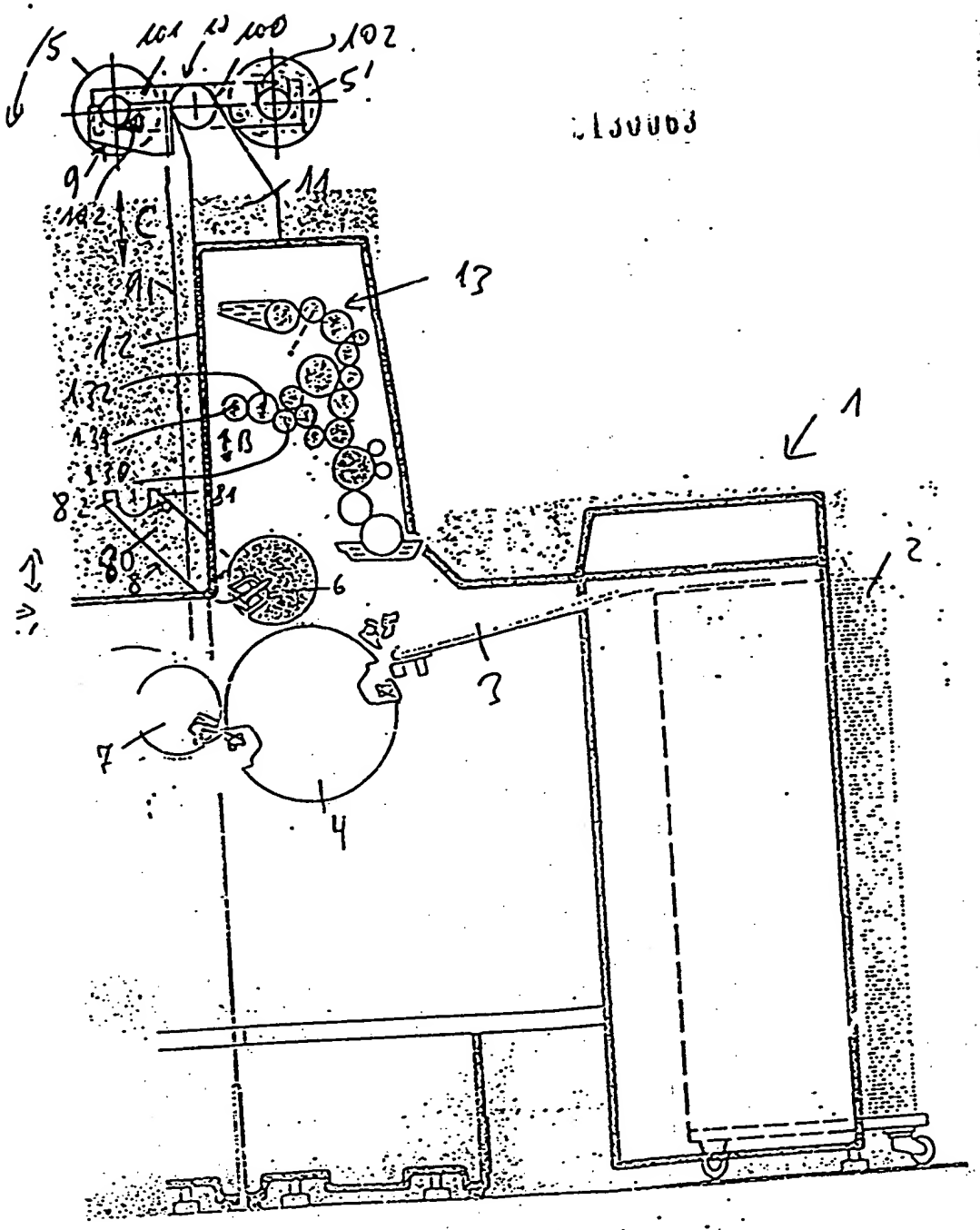

Fig. 3

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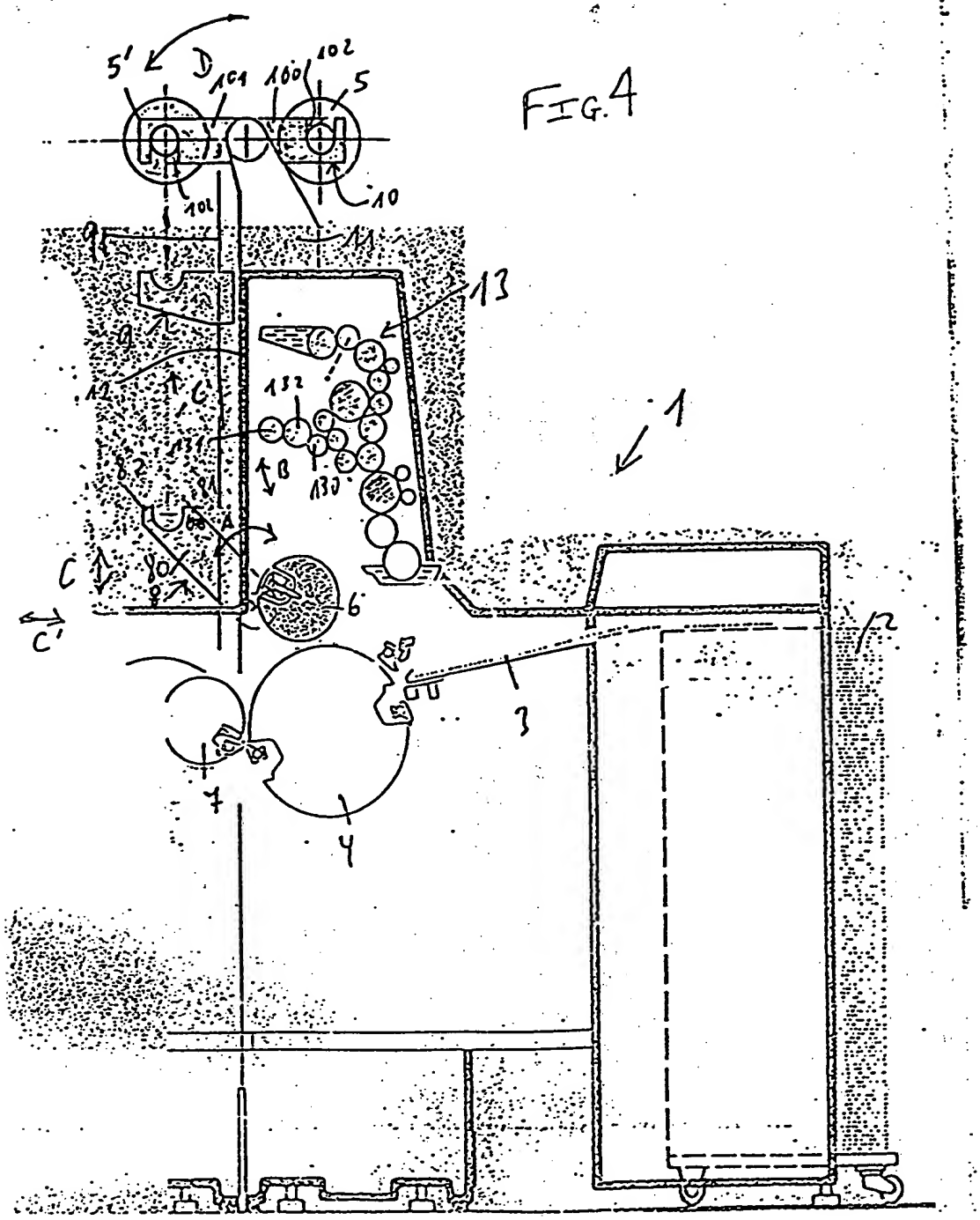
FIG.4



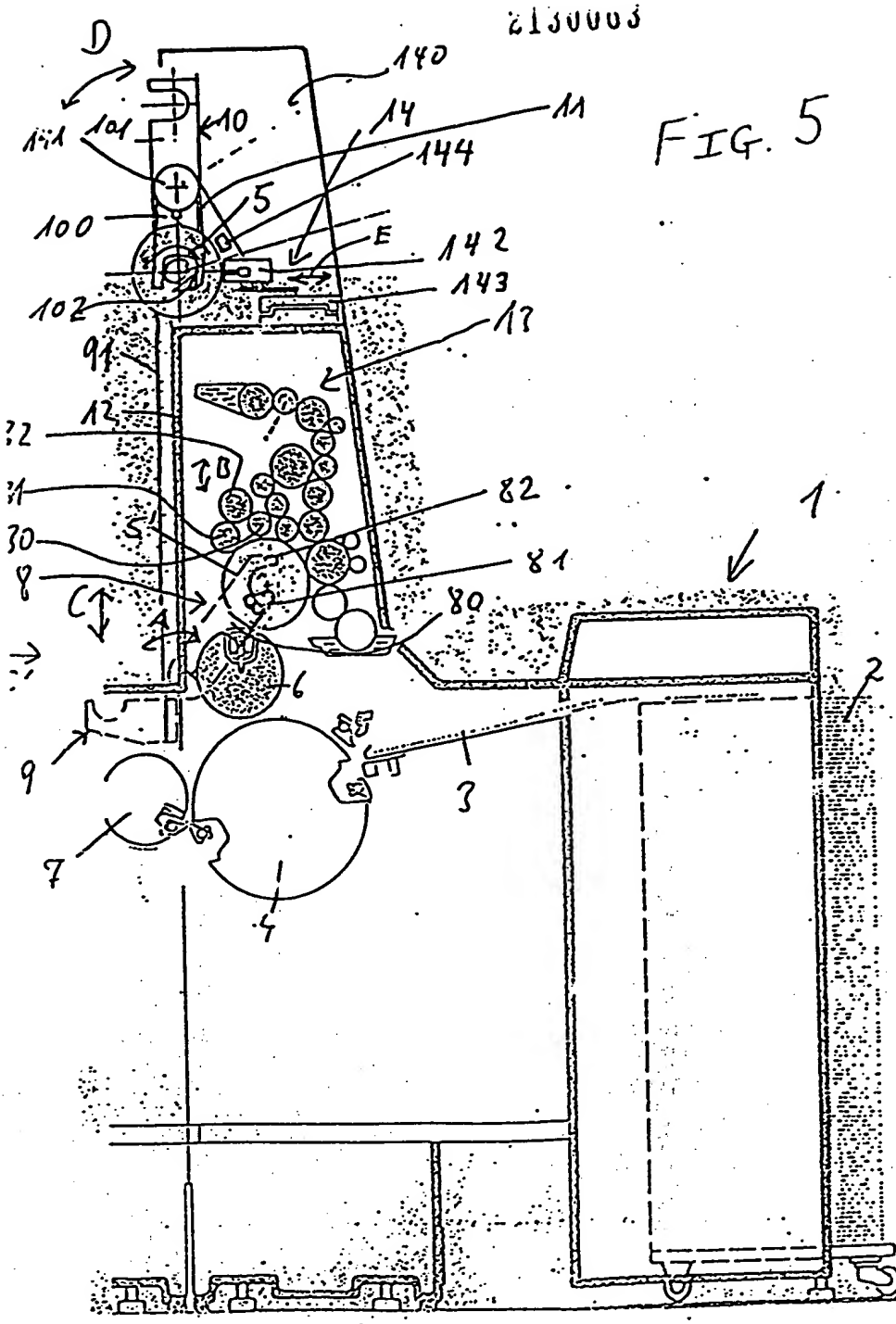


FIG. 5

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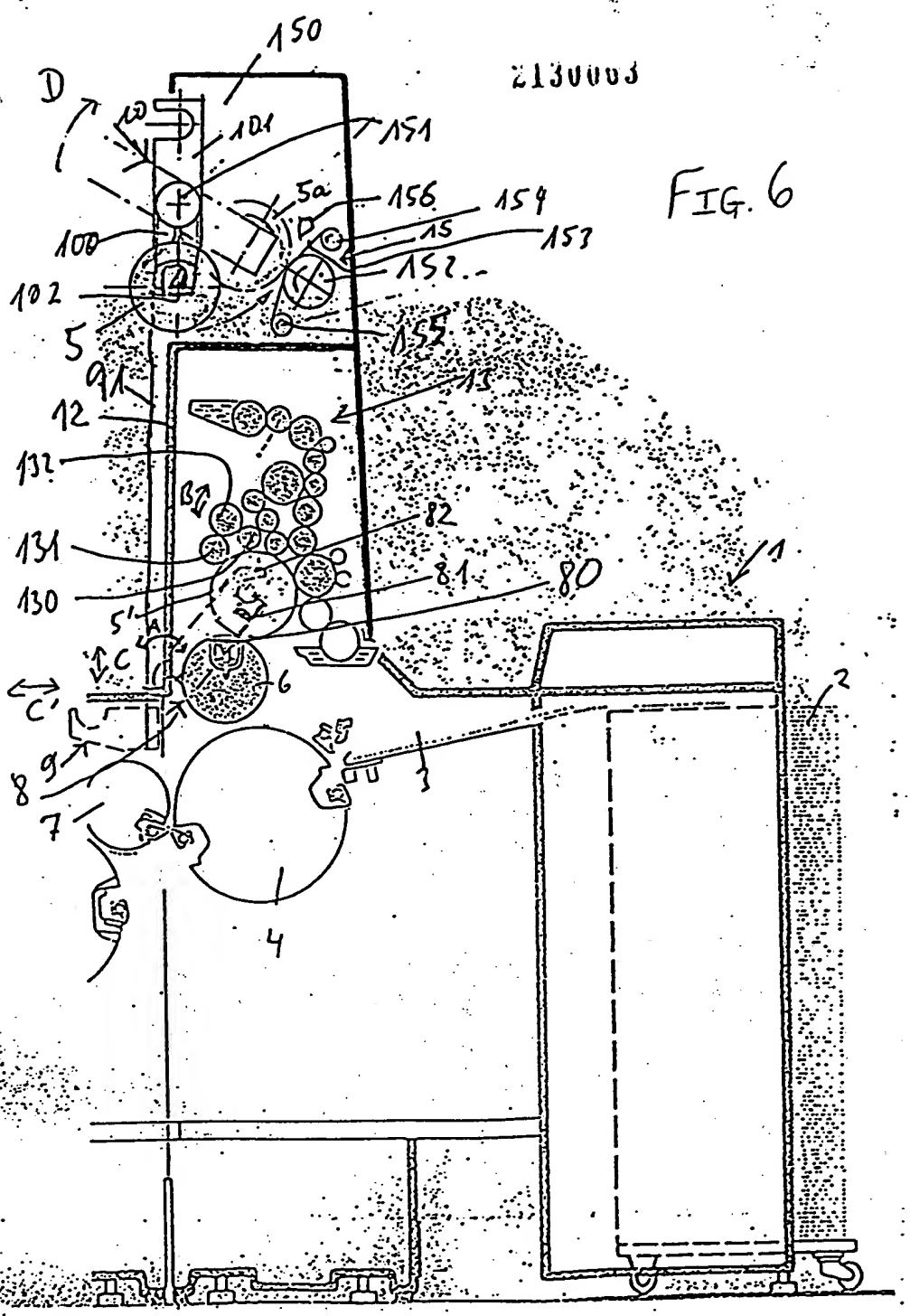

FIG. 6

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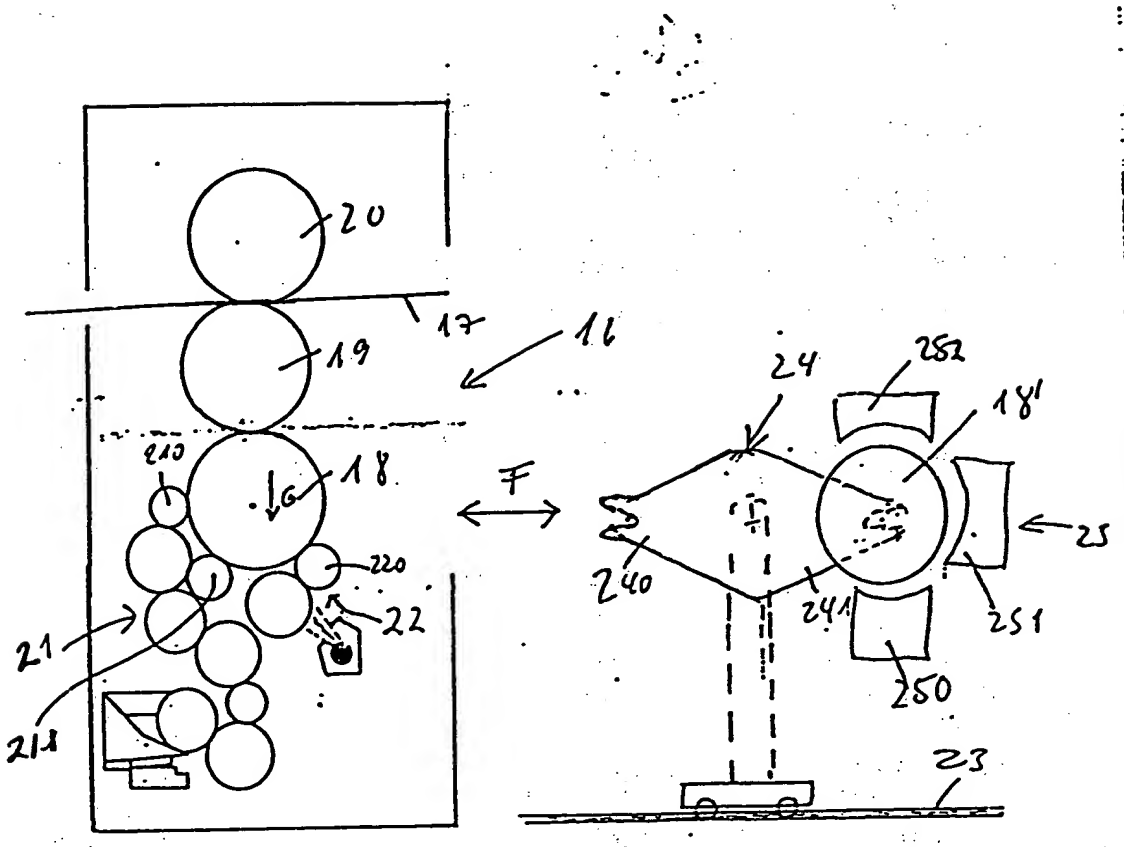

Fig. 7

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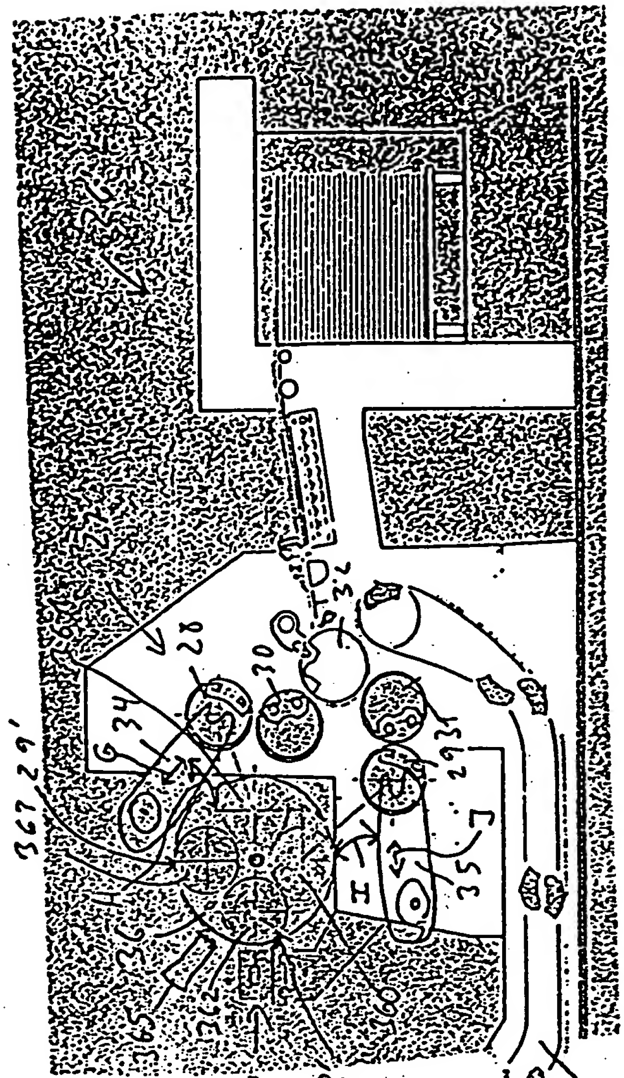

Fig. 8

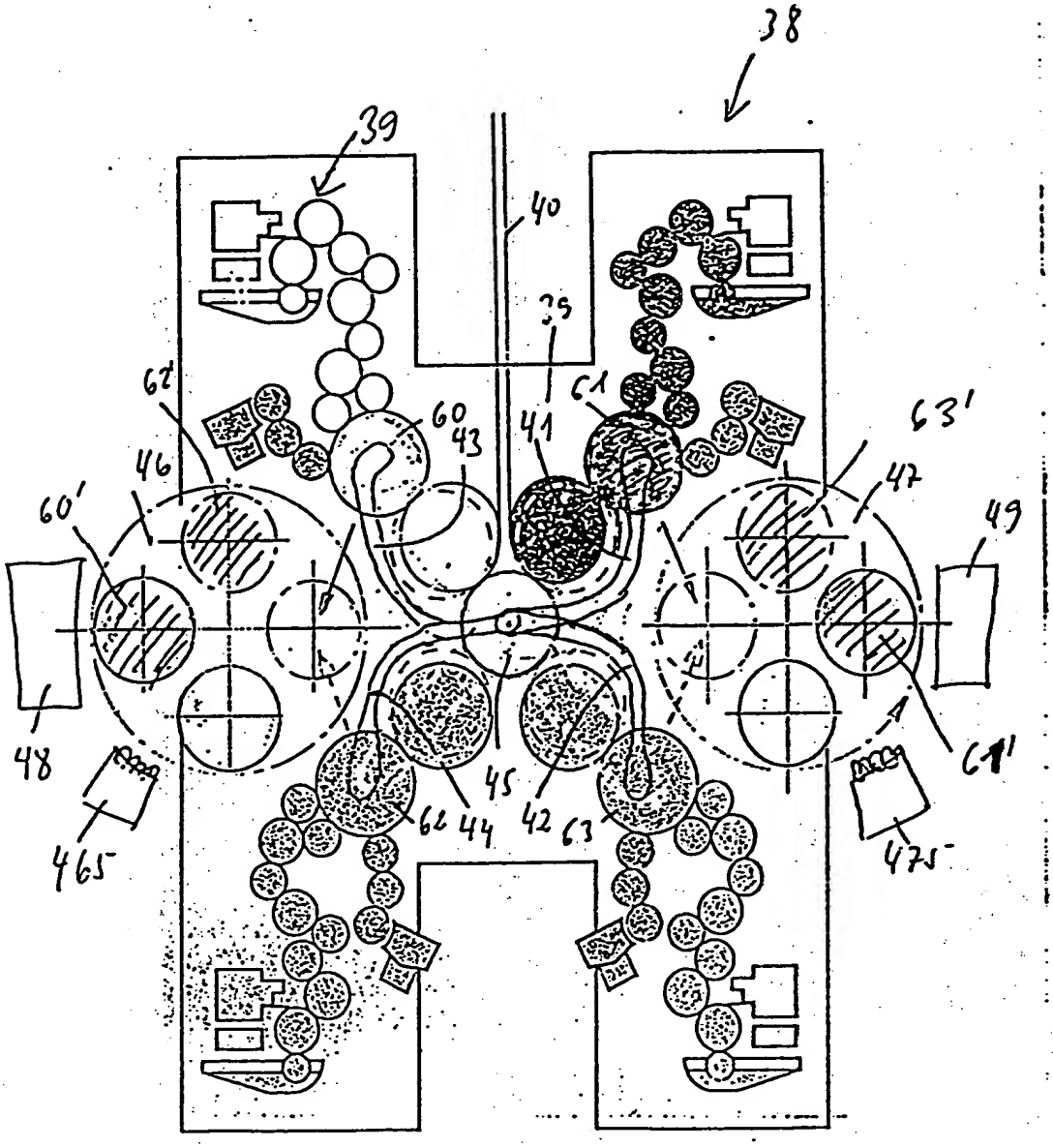

Fig. 9

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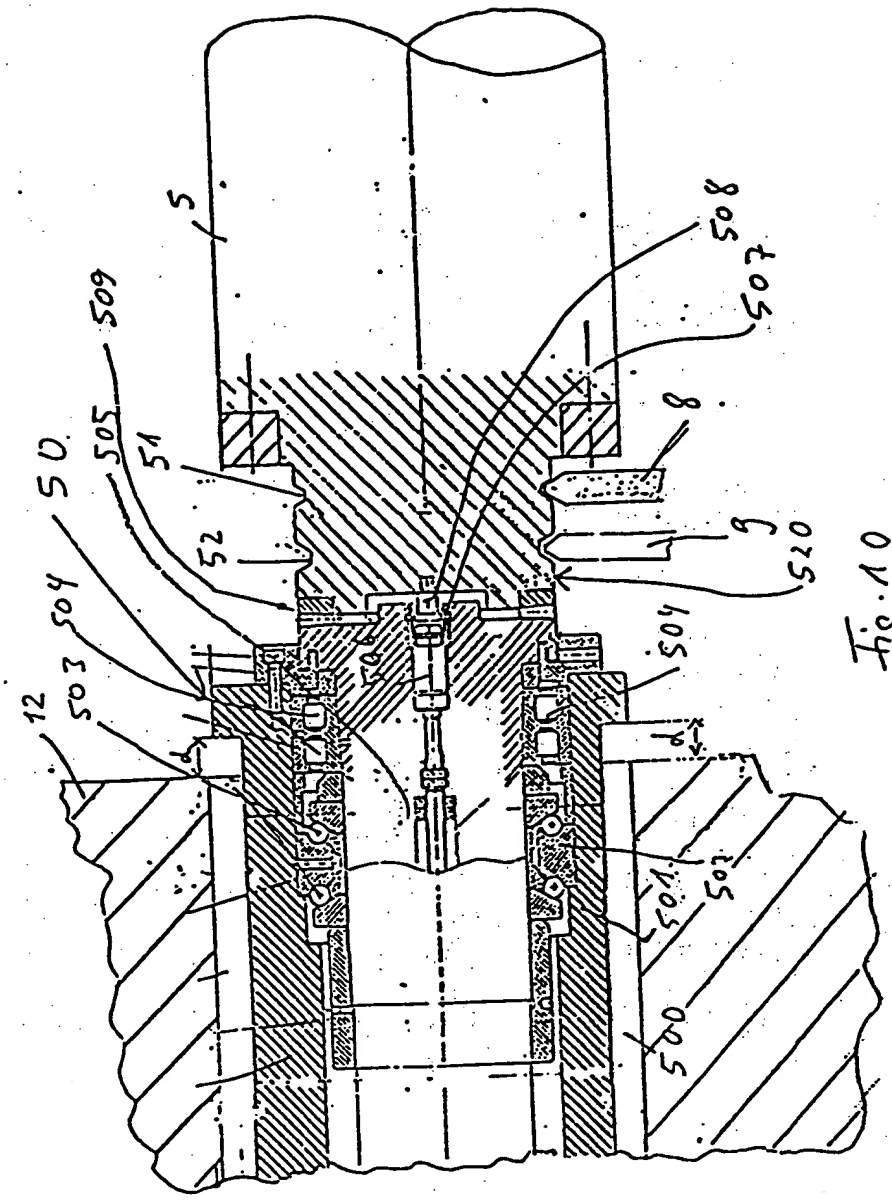

Fig.10

2130003

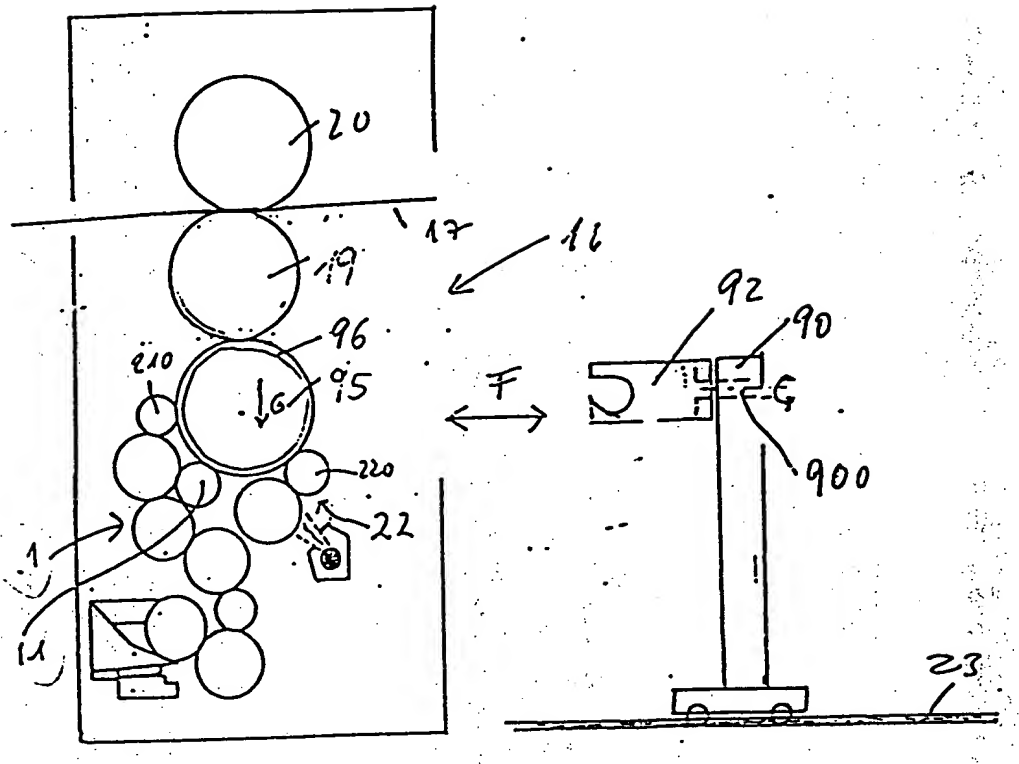

Fig.11

2130063

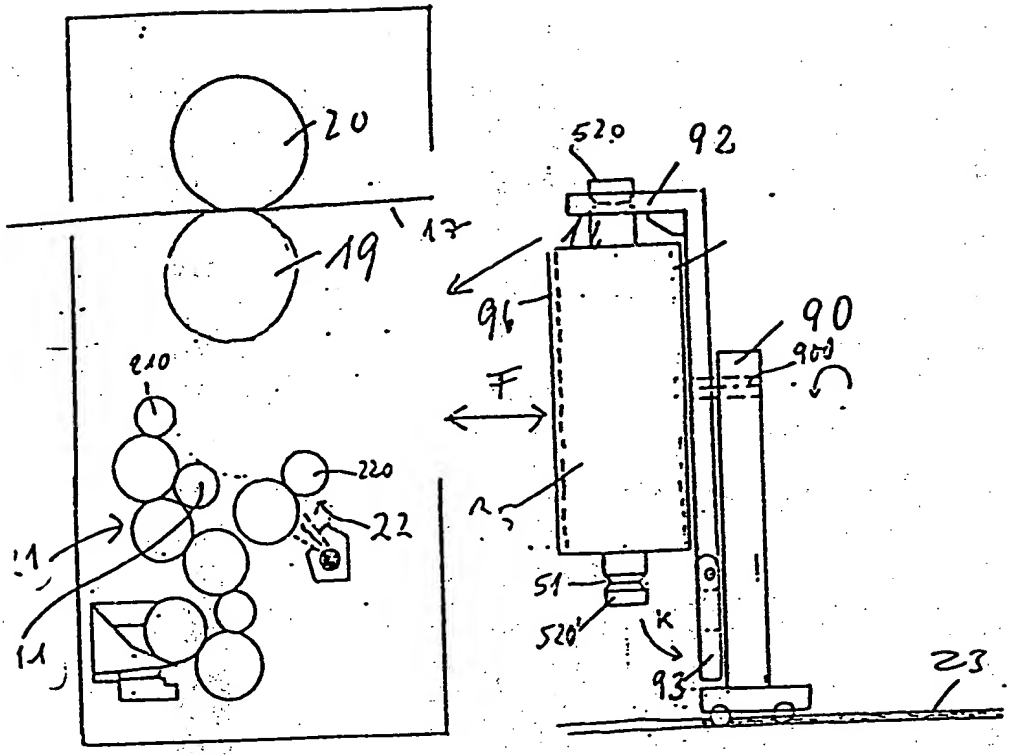

Fig.12

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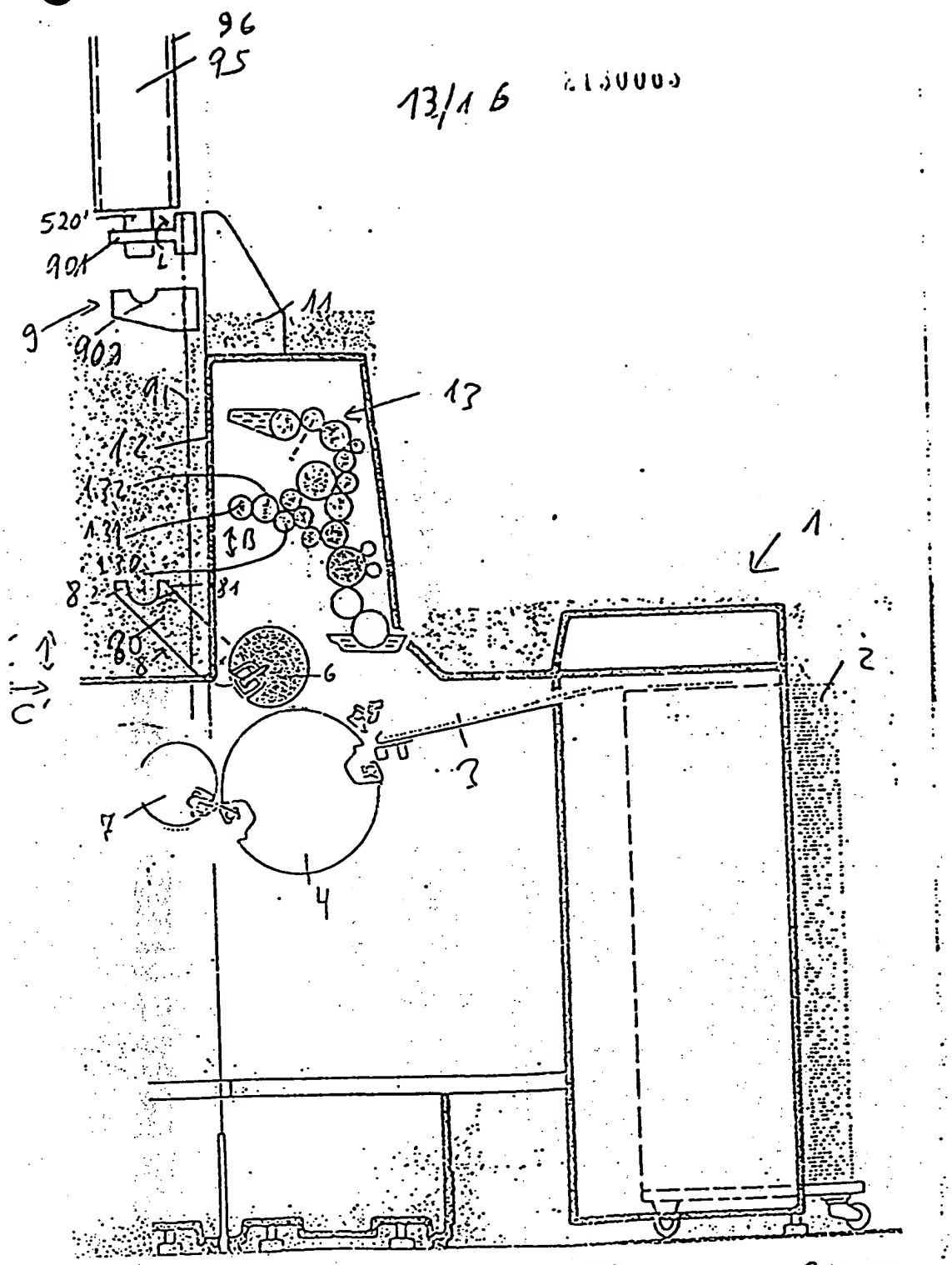

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FIG. 14

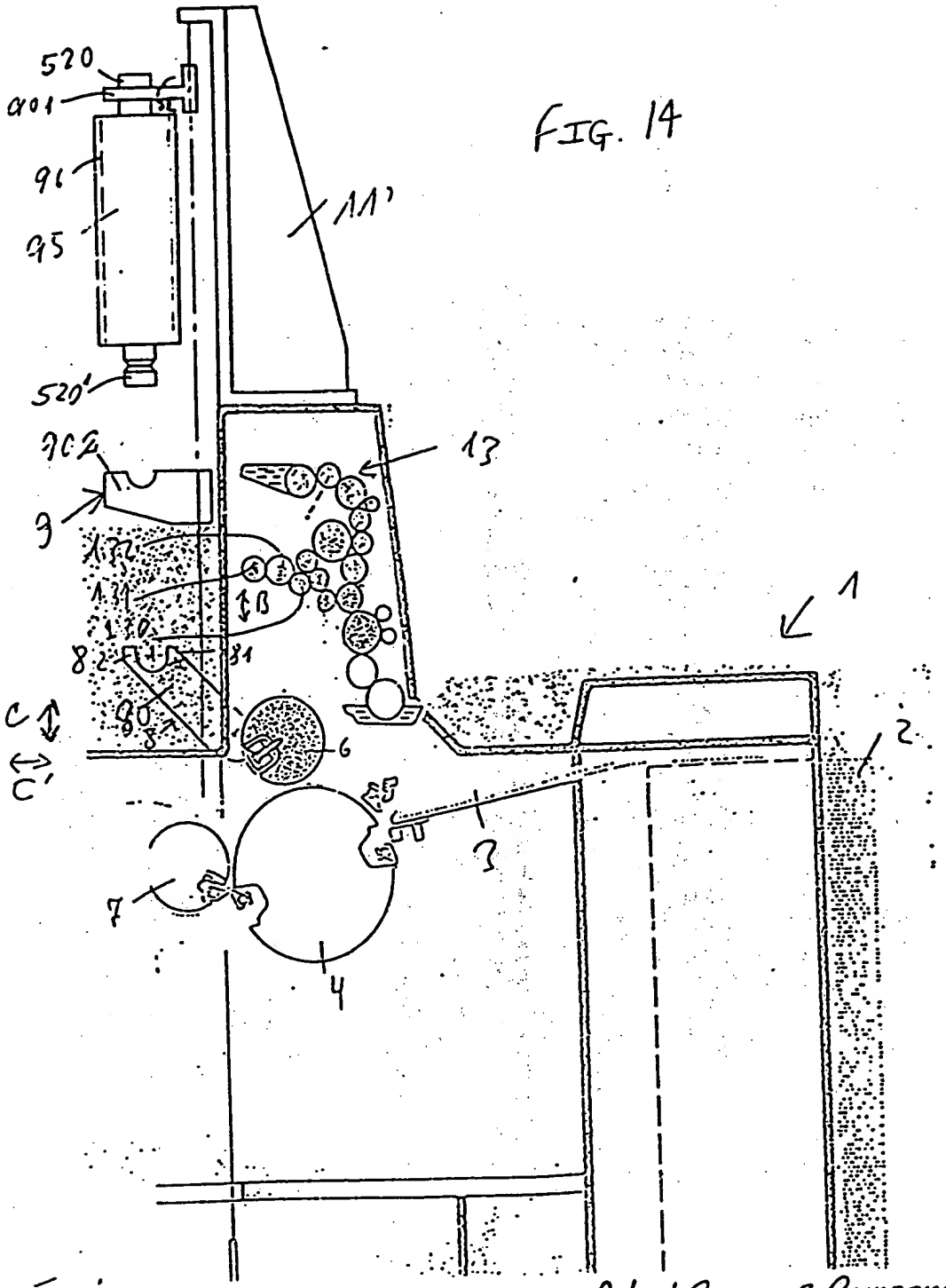

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FIG. 15

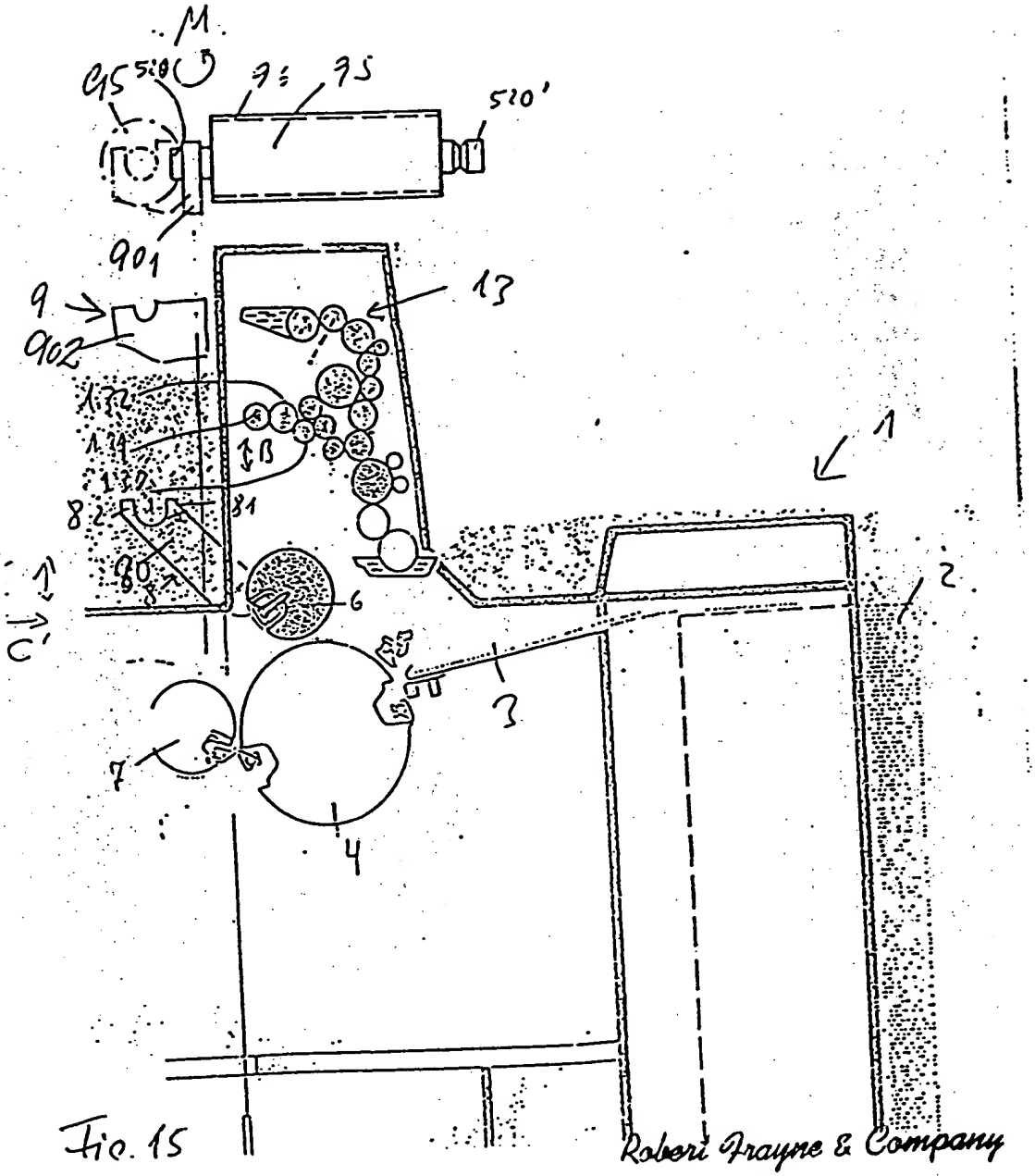

Fig. 15

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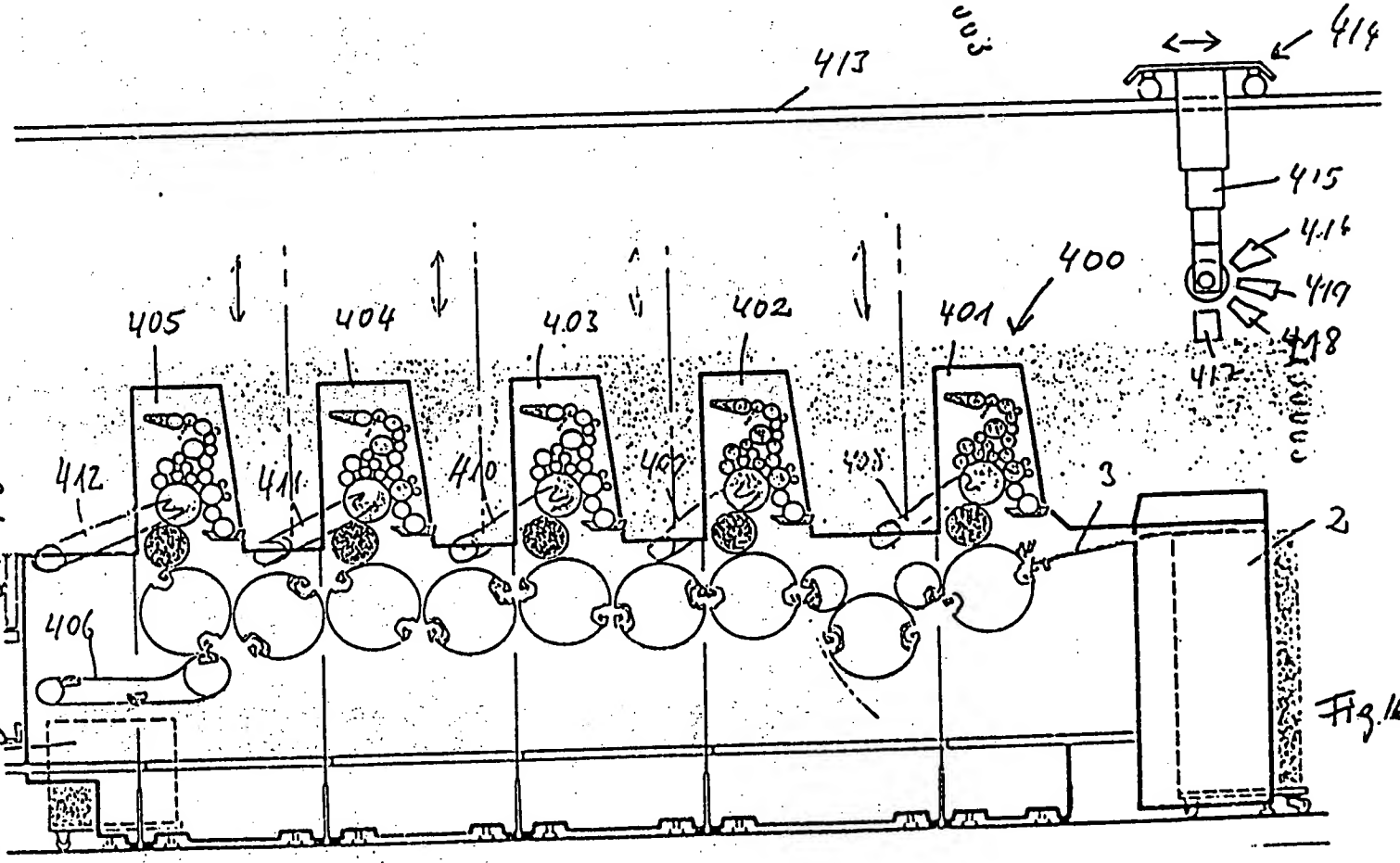

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Fig. 16